SPRING CONNECTION FOR VIBRATORY CONVEYOR

TECHNICAL FIELD OF THE INVENTION

The present invention relates to vibratory conveyors. Particularly, the invention relates to a system for attaching base mounted springs of a vibratory conveyor to a trough member.

BACKGROUND OF THE INVENTION

Vibratory conveyors are used in many industrial material handling processes to convey bulk process material from one point in the process flow to another. For example, in the snack food industry, vibratory conveyors are used to convey and distribute potato chips, popcorn, corn chips and the like, from the cooking processes to the packaging machines. Such vibratory conveyors are generally of the resonant, two mass design to minimize operating power, and to isolate the generated dynamic operating forces from the support structure of the conveyor and other surrounding equipment.

A resonant, two mass design vibratory conveyor includes a base member that is supported by isolating spring members from a support structure. The spring members adapt the conveyor to the elevation required for the conveyor to be integrated into the material flow path. The base member in turn is connected to a conveying trough member by leaf springs extending between the base and trough members. The longitudinal axis of each of the springs is at a preferred angle to the vertical, imparting a directed force to the material during operation and causing the material to flow along the trough member.

The conveyor also includes a drive mechanism connected between the base and trough members. The drive mechanism acts to cause the base and trough members to vibrate or move back and forth relative to one another. The drive mechanism may be a motor and crank arm system; or an electromagnetic system with the electromagnet core connected to the base member and the electromagnet armature connected to the trough member; or a motor driven rotating eccentric weight exciter mounted to either the base member or the trough member, usually the base member; or some other similar drive system. The natural frequency of the conveyor's mass and spring system is set close to the operating speed of the conveyor to take advantage of the phenomenon of resonance, wherein energy stored in the spring system as it operates is returned to be in phase with the applied driving force. This setting reduces the power required to operate the conveyor to about 25% of what would be required in a direct drive system.

A typical practical conveyor uses several groups or stacks of leaf springs mounted between the base member and the trough member. The groups are spaced-apart along the length of the conveyor. Since the operating forces are applied through these spring groups, large dynamic reversing stresses occur at the spring group attachment points, and therefore the design for the attachment points must be very robust. To be practical from an overall weight, cost, and sanitary design perspective, the trough member is usually constructed of relatively thin stainless steel sheet stock. If the spring groups were mounted directly to the trough member, the side walls would be subjected to excessive vibratory stresses and would soon fail and tear out. Therefore, the spring groups are usually connected to a robust spring mounting bracket strongly welded to a mounting plate that is designed to spread the forces out to acceptably low stress levels along the trough member side wall, to prevent failure. The mounting plate is then typically welded or bolted to the trough member side wall.

Bolting the spring mounting plate to the trough member side wall is a low cost connection, making the design attractive competitively, but it has several drawbacks making it less desirable in operation. The heads of the bolts protrude into the flow of the material in the trough. This may create a sanitary problem. Fine particles can lodge in the crevices around the bolt head and provides a place for bacteria to grow, making it difficult to assure that cleanliness standards are maintained at all times. The heads of the bolts may disrupt smooth material flow in the trough and adversely affect material flow rate. Also, the bolts must be maintained tight to provide the required clamping force to prevent rotating of the bolt head and scoring of the trough interior wall, or even worse, the failure of the connection.

Some manufacturers, such as FMC Corporation's Material Handling Equipment operation, have used a combination cast spring bracket and mounting plate that is inert gas welded to the trough wall. The weld extends around the perimeter of the mounting plate for a secure, low stress, sanitary connection. This method addresses and eliminates the drawbacks of the bolted-on connection, but the design is less attractive competitively. The inert gas welding provides a neat, clean weld finish, but some post weld clean-up is still required, particularly on the interior of the trough wall where the weld heating can discolor the stainless steel side wall material. The trough wall must be buffed and polished to return it to its original condition. Also, the welding heat can cause distortion in the trough member side wall if not carefully applied, requiring straightening of the trough member and further polishing.

The present inventors have recognized that it would be desirable to provide a cost competitive spring connection while maintaining the sanitary and material flow characteristics of the welded mounting plate type spring connection.

SUMMARY OF THE INVENTION

The invention is directed to a vibratory conveyor and an apparatus and method to provide an effective and cost advantageous spring connection for connecting springs to a conveyor trough member, particularly, connecting springs to a relatively thin side wall of the trough member. The spring connection for the vibratory conveyor includes one or more fasteners that is (are) welded to the side wall. The connection includes a spring connection plate with a corresponding fastener hole to receive each fastener. A nut is threaded onto each fastener and torqued down to clamp the connection plate onto the side wall of the trough member. The spring connection plate carries a spring bracket with a mounting hole for connection to one or more springs.

According to the preferred arrangement, the vibratory conveyor includes a base member, a trough member having a side wall, and a plurality of springs, such as leaf springs, extending from the base member to the trough member to support the trough member from the base member. At least one fastener is provided having a head and a threaded shank. The shank penetrates through the side wall, and the head is fixed to the side wall. A connection plate is connected to at least one of the springs, and the shank penetrates the fastener hole of the connection plate. A nut is threaded onto each shank and tightened to fasten the connection plate to the side wall.

Preferably, the head of each fastener is welded all around to an inside surface of the side wall with the shank penetrating the side wall and extending outside the side wall.